

## BACKGROUND OF THE INVENTION

### I Field of the Invention

The present invention, relates generally to footwear, and more particularly to the fabrication of footwear that conforms to the wearer's foot.

### II Description of the Prior Art

The wearing of shoes, boots, sandals and other footwear has been a common practice for thousands of years. It has long been recognized that the comfort of the footwear to the wearer and the distribution of the wearer's weight and pressure are both optimized when the shape of the footbed, that is the portion of the shoe that supports the foot, conform to the shape of the foot. Footbeds have long been produced in a number of standardized sizes in an attempt to meet the great variety of shapes, sizes, and arches of humans.

When, for example, a conventionally made sandal or shoe, is initially put on, it is often relatively stiff and unyielding and thus uncomfortable. After a considerable length of time, usually measured in weeks, during which the wearer may experience considerable discomfort and even pain, the shape of the footbed is slowly modified by the pressure and weight of the wearer's foot so as to better conform to, and thus better fit, that foot.

In recognition of the desirability of having the footbed conform as closely as possible to the wearer's foot, many methods have been proposed for forming a footbed that achieves or closely approximates the shape of the wearer's foot. Most of these prior approaches involve the use of heat-moldable footbeds, gel-moldable footbeds or the use of other molding techniques to achieve the desired configuration of the footbed. For

example. US Patent No. 5,733,647 discloses a removable insole which is shaped to conform to the wearer's foot. After the insole is heated, the wearer places his/her foot on the insole, thereby forming an impression of his/her foot. The wearer then walks around with the thus-made insole inside of a shoe. This approach requires the use of heat and thus may burn the wearer during its fabrication. In addition, an insole fabricated by this process is unsuitable for use in certain footwear, such as an open-toed sandal, since the insole cannot remain in place in a sandal.

US Patent No. 6,523,206 discloses a custom orthotic sandal and a process for its construction in which a negative cast is taken of the wearer's foot from which a positive cast is then made. This procedure is, however, complex, relatively costly and time-consuming, and is thus of limited applicability.

US Patent No. 5,555,584 discloses a method of making a customized orthotic footbed for use in a sandal, in which a footbed composed of a gel is placed between a bottom sole and a lightweight top sole. The sandal is then worn, and as the wearer walks around, the gel takes on the shape of the wearer's foot. The sandal is removed, heated to a temperature of 130 degrees F. and then allowed to cool, whereby the gel in the footbed solidifies and retains a negative image of the foot. This process is, however, time-consuming and complex, and since it requires the use of heat, it exposes the wearer to possible harm. Moreover, since the entire sandal must be heated to solidify the gel, some of the other materials of the sandal may be damaged by the heat during the shaping process.

In other prior art approaches, such as those disclosed in US Patent Nos. 4,520,581; 4,128,951; 2,838,776; and 4,888,225, a chemical reaction is initiated in a

formable material in a footbed. The wearer then steps into the footwear or shoe to form an impression. The material is then allowed to cure before the footbed is used. In another approach to the making of a customized footbed, as shown in US Patent Nos. 3,641,688; 4,413,429; 4,433,494; 4,503,576; 3,895,405; and 4,901,390, a thermoplastic bottom layer of a shoe or sandal is heated and thus softened. The wearer steps into the shoe and makes an impression, after which the material cools, retaining the impression of the wearer's foot. As in the earlier-described prior approaches, the need for heating and cooling increases the time and cost of the process while exposing the wearer to possible injury and burns, particularly when the wearer places his/her bare foot on the heated footbed. These prior art processes also often require the use of heating devices such as a microwave oven for its practice, which further increases their cost and complexity.

#### SUMMARY OF THE INVENTION

It is accordingly an object of the present invention to provide a customized footbed for a sandal, shoe or other article of footwear, which avoids the deficiencies of the prior art approaches.

It is a further object of the present invention to provide a method and article for forming a customized footbed in a safe, environmentally sound, efficient, reliable and cost-effective manner.

It is yet a further object of the present invention to provide a renewable footbed in which the components are reusable or recyclable.

It is another object of the invention to provide a method and article of the type described in which injury or burns to the wearer are avoided and which can be achieved in a simple and rapid manner with minimum effort by the wearer.

To these ends, in the practice of the present invention, the footbed includes a moldable, gel-like material which is hardened or solidified when it is exposed to sunlight. The gel-like material, after being thus solidified, preferably retains some degree of cushioning, malleability, elasticity, durability, and/or flexibility. The wearer places his/her foot on the footbed, thereby to cause the gel-like material to be shaped to conform to the wearer's foot. The wearer then removes his/her foot from the footbed leaving an imprint of his/her foot in the footbed. The thus-modified footbed is then exposed to sunlight and the sun's energy causes the gel-like material in the footbed to harden or solidify and thus to permanently take on the shape of the wearer's foot.

#### BRIEF DESCRIPTION OF THE DRAWINGS

To the accomplishment of the above and such further objects as may hereinafter appear, the present invention relates to a method and article for use in the fabrication of a customized footbed for use in an article of footwear such as a sandal or a shoe, substantially as defined in the appended claims and as described in the detailed description of a preferred embodiment thereof as considered with the accompanying drawings in which:

Fig. 1 is an elevation of a typical footbed that can be used in the performance of this invention;

Fig.2 is a cross-section taken along the line 2-2 in Fig.1;

Fig.3 is a cross-section similar to Fig. 2 illustrating a further step in the fabrication process;

Fig.4 is a perspective of a sandal including a footbed made according to the present invention; and

Fig. 5 is a cross-section similar to Fig. 3 illustrating a step in an alternative method according to another embodiment of the invention.

#### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the drawings, there is shown in Fig. 1 a moldable footbed generally designated 10, which as therein shown, is generally in the shape of a human foot having a toe end 12, a heel end 14 and a central arch portion 15. A thong or toe strap 17 is secured to the forward end of the footbed 10. The thong or toe strap 17 may be made either of hemp, a standard cloth-like fabric, a biological nutrient that can be returned to the biological cycle, or a biodegradable cloth-like fabric such as that sold under the trade name Polyactide by Cargill Dow of Minnetonka, Minnesota.

As shown in Fig. 2, the unformed footbed 10, prior to being molded to conform to the wearer's foot in the manner described below, includes an upper contact layer 16, a lower or bottom layer 18 and front, rear and side walls 20 and 22. The upper layer 16 is preferably relatively thin, typically between 1/16 and ½ inch, and is made of a flexible or moldable material made up of a foam rubber material, a rubber material, a biodegradable foam rubber, a biodegradable plastic material, a recyclable foam rubber, a recyclable plastic, or a plastic. As described in greater detail below, upper layer 16 may be either transparent or opaque to sunlight. In the case that upper layer 16 is transparent, bottom layer 18 may be either transparent or opaque; when bottom layer 18 is transparent, upper layer 16 may be either transparent or opaque.

Lower layer 18, and layer 16, when it too is transparent, should be sufficiently thin or sufficiently clear to allow sunlight to freely pass therethrough. Layer 18 should also be sufficiently strong to sustain extensive wear since, in use, it will come into

contact with the ground. The side walls 20,22 may also be made of a clear, flexible foam rubber material, a rubber material, a biodegradable foam rubber, a biodegradable plastic material, a recyclable foam rubber, a recyclable plastic, or plastic.

The enclosure formed by layers 16, 18 and walls 20, 22 is filled with a resilient foam rubber material 23 in which is disposed bladders or sacs 25 each of which is preferably clear and filled with a moldable gel material 24. Layer 23 may be made of a biodegradable foam rubber, a biodegradable plastic material, a recyclable plastic material, or plastic, all of which may be clear or transparent. Depending on which of the layers 16, 18, 20, or 22 is clear or transparent, the material 23, which is in contact with the relevant layer, should also be clear, thereby to allow ultraviolet light to pass through it and reach the gel-like material 24. Partial areas of material 23 may be clear or the entire material 23 may be clear. Material 23 may be of any convenient thickness depending on the amount of cushioning desired for either layer 16 or 18.

In accordance with one aspect of the present invention, moldable material 24 has the characteristic that after it is exposed to sunlight or ultraviolet rays for at least a predetermined period of time, it sets, hardens or solidifies to thereafter assume a permanent shape. A gel material having such a sun-hardening ability is a polyester resin that includes a styrene monomer. The polyester resin also contains an ultraviolet catalyst or photo catalyst, which when it is exposed to ultraviolet rays or sunlight, causes a reaction in the polyester resin causing it to solidify. A photo catalyst or ultraviolet catalyst of this nature is sold under the trade name Irgacure 2022 by Ciba Specialty Chemicals Inc. A polyester resin having this general composition and characteristics is sold under the trade name DING ALL SUN CURE by D. Sea International of Atlantic

Beach, Florida. Other polyester resins that may be used as the gel-like material 24 include Envirez 1807, an unprompted polyester that utilizes grain-derived organics from soybeans and corn, and an environmentally friendly soybean oil-based polyester resin containing an ultraviolet catalyst or photo catalyst sold by Cara Plastics Inc. of Newark, Delaware. Adding a plasticizer to the resin is useful if it is desired that the resin retain some degree of cushioning, malleability, elasticity, or flexibility in the resin after it has been solidified by exposure to the sun, and may also increase the durability of the solidified resin. Increased cushioning and the like of the solidified resin may also be achieved by reducing the amount of ultraviolet or photo catalyst used in the resin.

When it is exposed to bright sunlight, when moldable material 24 is the aforementioned SUN CURE polyester resin, it will fully set or solidify in between 2 to 6 minutes and preferably between 4 and 6 minutes; in partial sun complete hardening of material 24 will occur between 6 and 8 minutes after exposure to sunlight; and in a light overcast condition, hardening of material 24 will occur between 8 and 20 minutes after exposure. Other sun-curable materials may require different periods of exposure to sunlight to harden or solidify. If desired, rather than being encased in bladders such as 25, the gel material 24 may be injected or infused into the foam rubber material 23.

In the practice of the method of the invention, the wearer selects a right-foot and a left-foot unshaped footbed 10. Thereafter, as in the embodiment of the invention illustrated in Figs. 2 and 3, in which both upper and lower layers 16 and 18 are transparent, the wearer places one of his/her feet onto the upper surface of upper layer 16. The pressure of the foot acts through the foam rubber material 23 onto the moldable gel material 24 so as to cause the material 24 to be molded or shaped as a negative

impression of the wearer's foot. It will be noted that at no time during this operation does the wearer's foot come into contact with the gel material 24.

As shown in Fig.3, after the wearer has thus created an impression of his/her foot, the now-shaped gel material 24a includes a central portion 28 at the location of the arch, a depressed heel portion 30 and a ball and toe portion 32, all of which conform to the corresponding portions of the wearer's foot. Thereafter, as also shown in Fig. 3, the wearer removes his/her foot from the upper surface 16 of the molded footbed, which is then placed in sunlight or under a source of UV radiation so that sun rays or UV rays 34 are directed onto the upper surface of the molded footbed and through the transparent layer 16, through the foam material 23, and possibly also through the transparent end and side walls 20,22, to strike the molded gel material 24a for a predetermined time period, thereby to cause the material 24a to harden or solidify into a permanent impression of the wearer's foot. As noted above, the time during which the molded gel material 24a is subjected to the radiation is determined by the state of sunlight then prevailing. That is, during bright sunlight, exposure should preferably be between 2 and 6 minutes; for partial sun, between 6 and 8 minutes; and for a light overcast, between 8 and 20 minutes. The thus-fabricated sandal, illustrated in Fig. 4, is molded and shaped to conform accurately to the shape of the wearer's foot. The process described above is then repeated to form a molded, shape-conforming footbed and sandal for the wearer's other foot.

In the embodiment of the invention illustrated in Fig. 5, the upper contact layer 16 is opaque to sunlight and lower layer 18 is transparent. Side walls 20 and 22 may also be transparent in this embodiment if desired for aesthetic or functional design reasons. This arrangement is preferable when, for example, it is desired to shield the gel material 24

and foam material 23 in the completed footbed, thereby keeping the gel-like material 24 out of sight, or when it is desired to use a thicker contact layer to provide improved cushioning to the foot. In this embodiment, after the wearer has placed his/her foot on the contact layer to create an impression of the foot in the moldable gel material 24, in the manner described above, the footbed is inverted so that the transparent layer 18 is now the upper layer, and the inverted footbed is exposed to sunlight 34 (Fig. 5), which freely passes through transparent layer 18 to the molded material 24a for at least the predetermined time described above, thereby to cause material 24a to harden or solidify in the shape of the wearer's foot in the manner previously described with respect to the first embodiment. After the material 24a has solidified, the completed footbed is again inverted so that layer 16 containing the toe strap 17 is again the upper layer.

In the event the customized shaped footbed, fabricated in the manner described above, is to be used as part of a covered sneaker, shoe or boot, a shoe, boot or sneaker upper, rather than the sandal toe strap is secured to the upper layer 16. The presence of the upper secured to layer 16 will prevent sunlight from penetrating through layer 16 so that the method illustrated in Fig. 5, in which the sunlight passes through the transparent layer 18, is used to form the customized footbed. In order to prevent the premature hardening of the moldable gel material 24 by premature exposure to sunlight, the unmodified or unshaped footbed is desirably wrapped in an opaque material prior to the wearer's placing his/her foot on the footbed to create an impression of the wearer's foot in the gel material.

It will be appreciated that the present invention allows for the safe and simple construction of a custom-fitted article of footwear that is, from the time of its fabrication,

shaped to conform to the wearer's feet. It will also be understood that the invention may be used to fabricate a removable insole which can be inserted and removed from an article of footwear. It will be further appreciated that modifications may be made to the specific embodiment of the invention described hereinabove without necessarily departing from the spirit and scope of the invention.